Thinking about how to best form scientists:

Incorporating toxicology, public and environmental health risks into the curriculum

Laura Deakin
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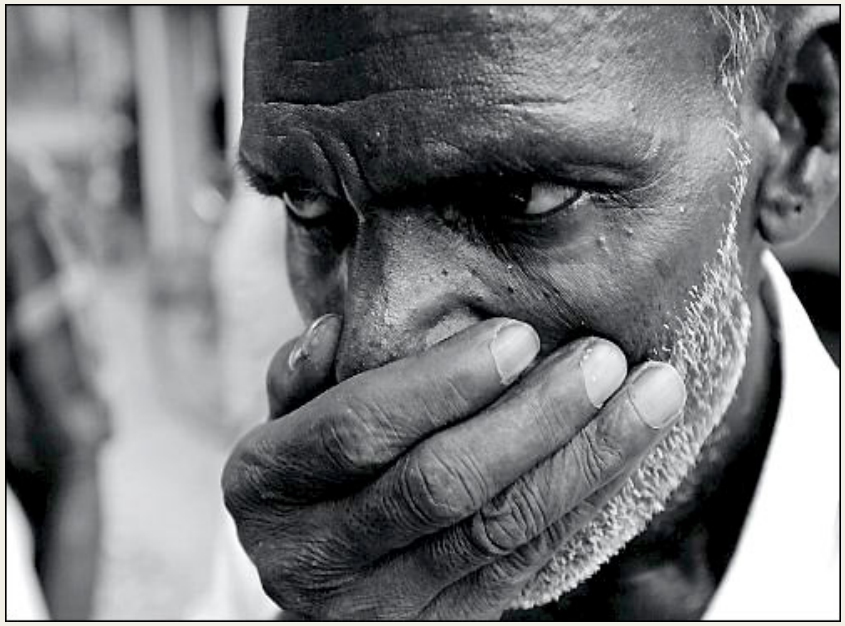
Last Week in the News: Asbestos



Indian worker describes how he would cover his face while working with asbestos from Canada.

Globe and Mail.
October 2007

What is asbestos?
Why are we still talking about asbestos?
Why is Canada exporting this if we're ripping it out of our buildings?

Objectives

1. **Public Health for General Science Students**
   Introducing toxicology and ecotoxicology
2. **Occupational Health Risks**
   Responsibility towards those at highest risk
3. **Nanotechnology: University of Waterloo**
   Helping shape emerging disciplines
4. **How to Make it Work**
   Shaping the curriculum and sharing the load

The General Science Student:
Understanding Consumer Products

Jan11/2010

Toxic cadmium taints kids' jewelry

Product safety authorities probe products from China

Wal-Mart has pulled items from shelves after lab tests showed some were made almost entirely of the toxic metal.

Cd is an IARC class 1 human carcinogen…but what does this mean?

Connect with what is in your home

The General Science Student:
Understanding the Environment

Link reactivity to persistence and biomagnification

In herring gulls eggs (µg/g)

	1979	1981	1982
DDE	3.4	4.7	7.5
PCBs	38	44	60
Mirex	0.25	0.42	0.60

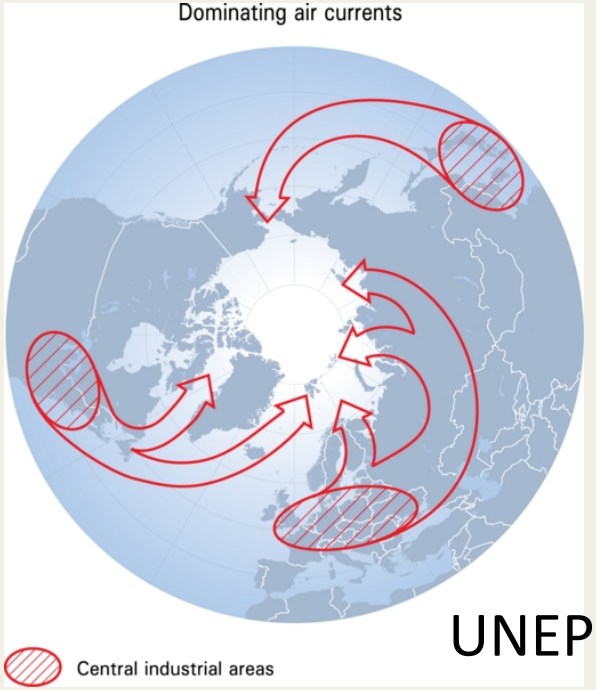
1986, sediment (µg/g):

Cd	2.5	Hg	0.48
Pb	81	As	3.2

http://www.ilec.or.jp/database/index/idx-country_name.html

The General Science Student:
Understanding the Environment

Link volatility, solubility, reactivity to atmospheric contaminants (smog) and global distillation to the poles:



UNEP

Polar bear livers contained (2005):

PCBs, PBDEs, PFOS
DDT, Chlordane, HCH

Kannan et al. (2005) Environ. Sci. Tech.

The General Science Student:
Understanding Our Own Backyard

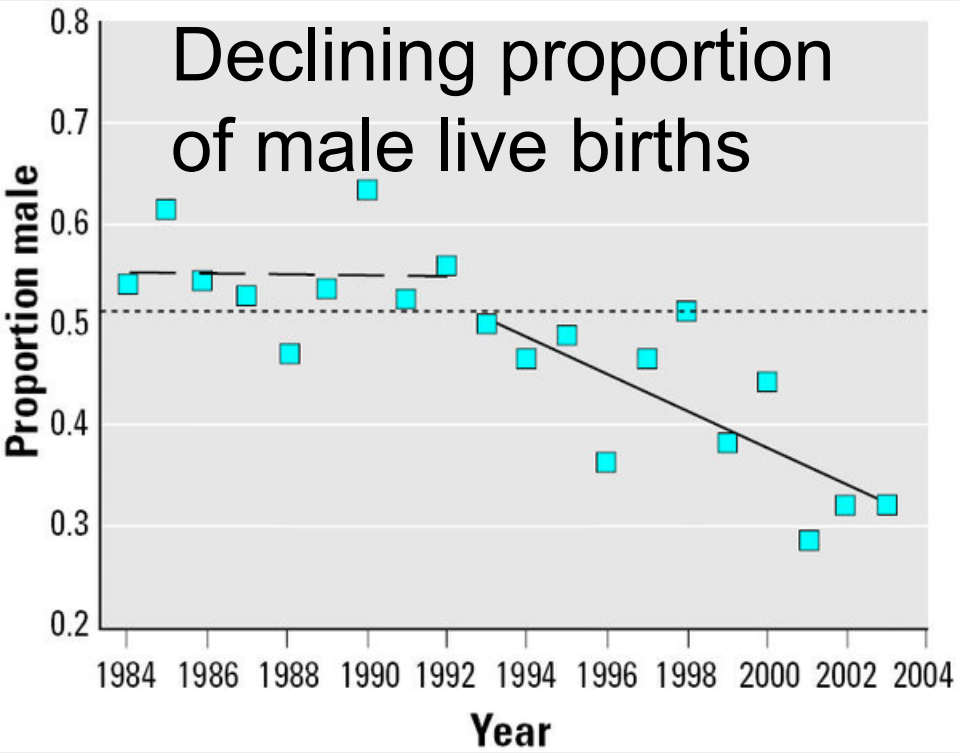
November 1, 2010

'Chemical Valley' spurs Ont. lawsuit

"The environmental group Ecojustice launched a lawsuit against Ministry of the Environment."

What's going on?

The General Science Student:
Understanding Our Own Backyard



http://toxnet.nlm.nih.gov/

"the nervous system appears to be the critical target for carbon disulfide induced toxicity"

The problem with epidemiology … humans are confusing

MacKenzie et al. 2005.
Environmental Health Perspectives

Occupational Health Risk

We've an obligation for our students headed towards high risk professions:

Chemistry, nanoscience, nanotechnology, chemical engineering, microbiology, genetics, pharmacy, dentistry, medicine…

Safety: More than a training session … a way of thinking

Basic safety training is provided.

Workplace Hazardous Materials Information System (WHMIS)

They will be working with nasty compounds in pure form.

Sodium cyanide

Benzene, anthracene

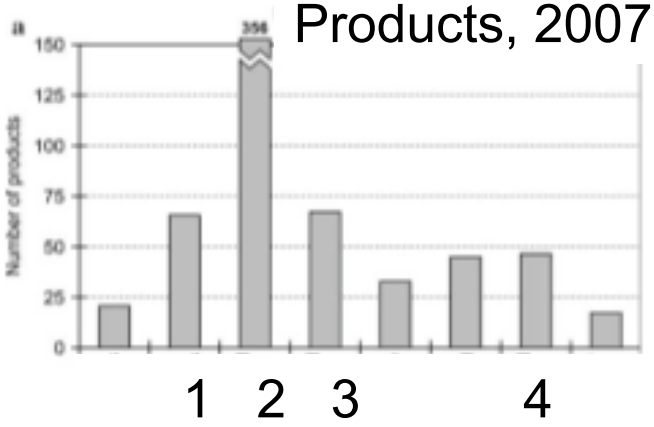
Heavy metals

Doing More than the Minimum

- *A graduate student leaves a broken bottle in a hallway, later saying they didn't know what teratogenic meant.*
- *An undergraduate student decides to "dry" the diethyl ether by putting it in an oven…*
- *A PhD student had some sodium on a spatula that ignites in the sink where there is an organic waste container.*

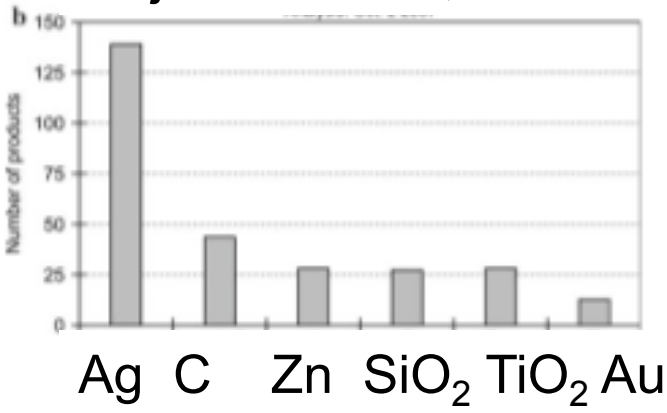
Nanoscience / Nanotechnology

Products, 2007



1: Food
2: Health/Fitness
3: Home
4: Computers/Electronics

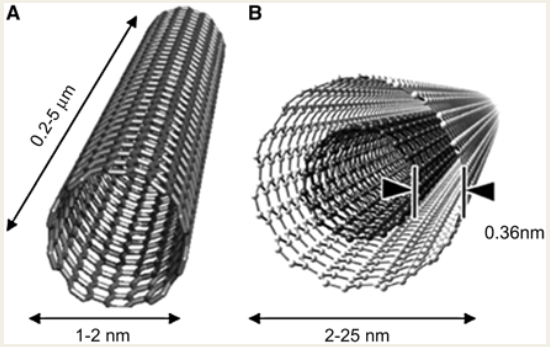
Major Materials, 2007

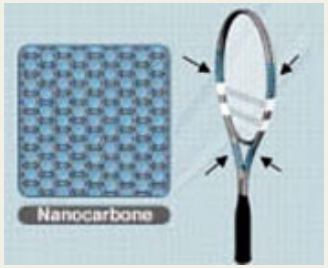


Hansen et al.
Ecotoxicology, 2008.

Woodrow Wilson PEN: http://www.nanotechproject.org/

Carbon Nanotubes: New materials we don't know that much about





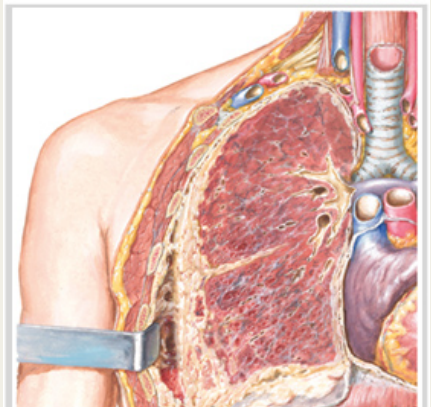
Ontario Permissible Exposure level (PEL)

Graphite (7782-42-5) (all forms <u>except</u> graphite fibres)

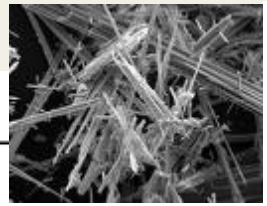
2 mg/m^3

No workplace regulations to protect workers

Carbon Nanotubes:
Mesothelioma in Mice



Mesothelioma



Crocidolite (asbestos)

Tagaki et al. J. Toxicol. Sci., 2008

Carbon Nanotubes:
MSDS for Workers

NANOLAB, INC.
179 Bear Hill Road
Waltham, MA 02451
Phone (781) 609 2722
Fax (781) 609 2899
http://www.nano-lab.com

Revised on July 30,2010
Revision no. 3

MATERIAL SAFETY DATA SHEE T

SECTION 1. - - - - - - - - - CHEMICAL IDENTIFICATION- - - - - - - - -

NAME: CARBON NANOTUBES, MULTI-WALL

SECTION 11. - - - - - - - - - TOXICOLOGICAL INFORMATION - - - - - - -
ACUTE EFFECTS MAY BE HARMFUL IF ABSORBED THROUGH THE SKIN. MAY BE HARMFUL IF SWALLOWED. TO THE BEST OF OUR KNOWLEDGE, THE CHEMICAL, PHYSICAL, AND TOXICOLOGICAL PROPERTIES HAVE NOT BEEN THOROUGHLY INVESTIGATED. MAY CAUSE SKIN IRRITATION. CAUSES EYE IRRITATION. MATERIAL IS IRRITATING TO MUCOUS MEMBRANES AND UPPER RESPIRATORY TRACT. MAY BE HARMFUL BY INHALATION, INGESTION, OR SKIN ABSORPTION.

Nanomaterial Health Risks Milestone

32 lectures over ~ 4 years

Nanomaterials Health Risk Assessment

Nanotoxicology

Nanomaterials Exposure Assessment

Consumer Products and Ecotoxicology

Nanomaterials Risks and Benefits

Required for Nanotechnology Engineers

Overall Goal

Can we address complicated topics that are important and often interdisciplinary?

Environmental justice Sustainability

Green alternatives Environmental impacts

Public policy Consumer products

Occupational Cancer

How to Make it Work

Introducing new courses? *Not likely*

Shared courses? *Maybe?*

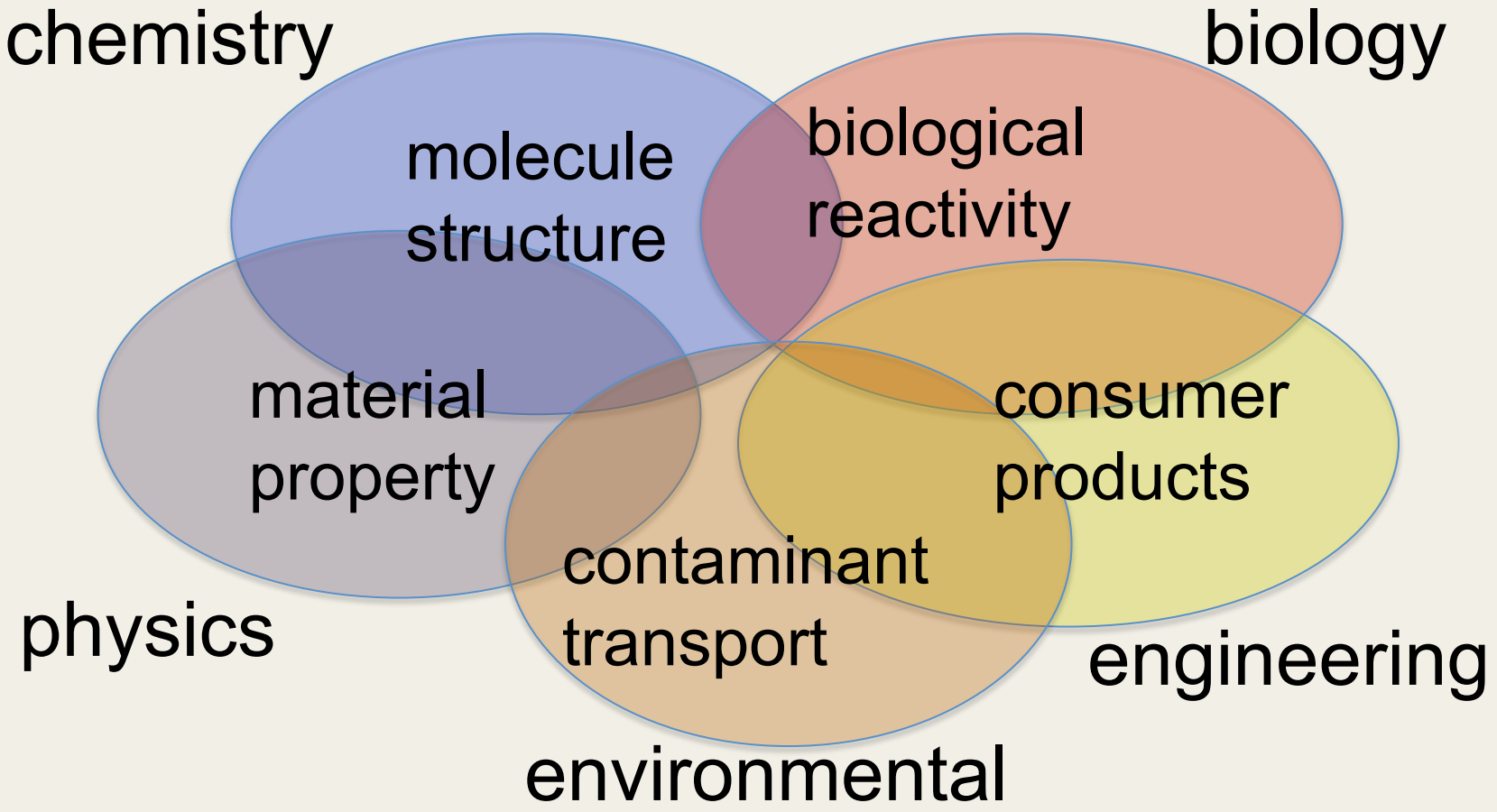
Invited Lecturers? *Probably, between depts?*

Sharing Material? *Why not?*

Sharing the Load:

Is there a way to build bridges and make room for interdisciplinary topics without compromising content?

Getting beyond your comfort zone



building bridges, borrowing from neighbours

The Goal of Context

Teaching in context:

Proving real world examples

An hour of toxicology of pesticides is not the goal of context.

Teaching by bridging:

Pointing beyond your field to another

ACKNOWLEDGEMENTS

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Emerging Disciplines Task Force – Nanotechnology and Molecular Engineering

Alana Lavoie